GUIDELINES FOR TEACHING MATHEMATICS

TO LOW ACHIEVERS

by

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INTRODUCTION

In the past decade, vast changes have taken place in the content and the techniques of teaching school mathematics in this country. Some have characterized these changes as a revolution.[1] Many of these changes, experimental only a few years ago, are now established in the curriculum. Large numbers of elementary school pupils are now studying the "new mathematics"; large numbers of college-bound secondary school students have profited from improved materials and teaching techniques.

In spite of the many changes that have taken place in school mathematics, there has been little change in the typical ninth-grade general mathematics class. This is not because teachers or students have generally been satisfied with this course. It is the writer's experience from observation and research that teachers and students dislike the general mathematics class.

General mathematics or other classes in mathematics for the low achiever have a great variety of objectives including a simplified treatment of algebra, proficiency in arithmetic

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[1] National Council of Teachers of Mathematics, The Revolution in School Mathematics. Washington, D. C.: National Council of Teachers of Mathematics, 1961.

skills, consumer mathematics, etc. School offerings vary from no mathematics class for the low achiever to six-year programs available in grades 7-12 at some schools.

The low achiever is found at all socio-economic levels and is estimated to make up one-third of the school population.[1] Society will be affected by these students and should therefore, prepare these pupils to become mathematically competent citizens. Everyday living requires certain mathematical skills. The individual of today is surrounded by figures: taxes, payroll deductions, bowling averages, calories, government expenditures, interest rates and life expectancy tables. Vocational training and job rehabilitation require proficiency of arithmetic skills.

In the past a limited amount of work and understanding were expected of a low achiever because the low achiever was classified as a student with low innate ability. For example, if a ninth-grade student with an IQ of 80 performed at the sixth-grade level his work was called satisfactory because this was all that was expected of him. Hand skills were supposed to be a low achievers best asset while handling abstractions was in impossibility. So--the student was assigned to a general mathematics class to be presented the

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[1]Sarah Greenholz, "Successful Practices in Teaching Mathematics to Low Achievers in Senior High School," _The Mathematics Teacher_, 55:329, April, 1967.

same material that was frustrating to him the previous six years. General mathematics is a class that provides large amounts of drill and review of basic arithmetic processes plus pages of written problems dealing with "everyday" situations.

Individuals and groups have begun to express concern for the low achiever and the possibilities of presenting a program that will better fit the needs of the low achiever. One of the well-known experimental programs is the School Mathematics Study Group (SMSG). This national group headquarters at Stanford, California, under the direction of Professor E. G. Begle and is funded by the National Science Foundation. The SMSG materials are the result of work by many people--psychologists, testmakers, mathematicians from colleges and industry, biologists, and high school teachers. In a letter to Science Magazine, February 11, 1967, Professor Begle made a public appeal for ideas to help create a better and newer "new math" to replace SMSG texts for grades 7-12 "before present materials become frozen into a newly orthodox pattern that will require a new revolution in a few years."[1]

Another experimental program that hopes to improve the mathematics program for low achievers is titled, A Program

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[1] E. G. Begle, "SMSG: The First Decade, "The Mathematics Teacher, 61:239, March, 1968.

for Mathematically Underdeveloped Pupils. It began in August, 1966, Palm Beach County, Florida, under the direction of Dr. Jack L. Foley. The project is financially supported by Title III, PL 8910 ESEA. Initially, thirty-four teachers participated in an inservice program during the summer. The inservice class was used to develop and disseminate materials and ideas plus suggested approaches and techniques. The project staff has developed their own units and is presently teaching from these materials and evaluating them.

Finally, hiring teachers who want to teach the low achievers is a problem. In the junior high school being able to teach a mathematics unit and challenge the gifted while keeping the material within reach of the low achiever requires three preparations for each class. When grouping of students has been done, often the first or second year teacher or less-capable teacher is assigned to these classes with few objectives beyond keeping class order. One of the most important tasks a teacher of the low achievers must perform is that of motivating the students. All students crave security and the slow learner needs to succeed most of all. Teachers require special training to teach the slow learner. The first year teacher cannot imitate the methods used by his former teachers as that first year teacher was now in a class for slow learners!

The following paragraph summarizes the kind of teacher the program for low achievers needs.

A teacher who accepts the fact that low achievers are teachable; a teacher who has a missionary spirit and a respect for the worth of pupils with limited ability; a teacher who is concerned and interested in individuals; a teacher who can make a pupil feel he not only belongs but also is important; a teacher who can instill a sense of worthiness; responsibility and desire to achieve; a teacher who cares enough to give his very best to low achievers will make the program a success.[1]

Some schools are now offering subjects especially for the low achiever and attention is being given to special teacher training for teachers of low achievers. With interest and action beginning to grow at the national, state, and local levels there seems to be help coming for the low achiever at last.

STATEMENT OF THE PROBLEM

The purposes of this study are to: (1) determine the characteristics of low achievers and develop methods of presenting daily lessons that low achievers can understand and learn, (2) find what materials are currently available to help teach low achievers in mathematics, and (3) identify a suitable content for the low achiever at the secondary level, considering the two items above.

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[1] From the Preliminary Report of 1964 USOE-NCTM Conference as quoted from Bruce E. Meserve, "The Teaching of Remedial Mathematics," *The Mathematics Teacher*, 59:439, May, 1966.

DEFINITION OF TERMS

General Mathematics. A class designed to include the low achievers. Test results and teacher recommendation will determine the students enrolled in this class.

Low Achiever. Any student who ranks below the 30th percentile in mathematical achievement is normally termed a low achiever.[1] Students classified as low achievers do not necessarily share the same causes of this characteristic. Special terms are often used to identify the specific cause of low achievement. Some of these terms are slow learner, underachiever, reluctant learner, disadvantaged learner, culturally deprived learner, disaffected learner, rejected learner, or the terminal student. These terms are used throughout this paper as synonyms for low achiever.

LIMITATIONS

In terms of IQ the literature classifies the slow learner in the 75-90 IQ range. There is another group of students with less than 75 IQ that are referred to as "educable". These students are placed in special education classes if available therefore, this paper does not include such students.

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[1] Max Sobel, Teaching General Mathematics, (Englewood Cliffs, New Jersey: Prentice Hall Inc., 1967) p. 1.

DESIGN AND PROCEDURES

This study involved findings based on a review of literature in the Kansas State University Library. Pertinent literature was identified and located with the use of such references as the Education Index and Dissertation Abstracts. An interview was also conducted with Dr. Jack L. Foley of Palm Beach County, Florida.

CHAPTER II

CHARACTERISTICS OF THE LOW ACHIEVER

It is widely recognized that the typical general math-
ematics program attempts to meet the needs of a number of
different types of individuals, all classed as low achievers.
What sets these students apart from average students? It
is appropriate to examine what has been written about some
types of low achievers. First, a look at the slow learner;
the slow learners being one of the largest segments within
the low achiever group.

Although some writers state that slow learners are
essentially normal in their emotional, social, physical,
and motor development, others point out many differences.
Following are some that are most frequently cited, in com-
parison with children considered intellectually normal:

(1) Short attention and interest span. (2) Limited
imagination and limited creative thinking. (3)
Slow reaction time. (4) Apathy, diffidence, depen-
dence, placidity--but frequent presence of excit-
ability, sensitivity. (5) Academic retardation
especially in reading; achievement age lagging
behind chronological age. (6) Absence or easy loss
of self-confidence. (7) Gullibility, instability,
shyness, submissiveness. (8) Low power of reten-
tion and memory. (9) Inability to do abstract
thinking, to handle symbols, to evaluate results,
to foresee consequences of acts. (10) Failure to
transfer ideas, to extend beyond local point of
view in time or place, to retain interest if
results are deferred or intangible. (11) Limited
powers of self-direction, of adapting to change in

situations and people. (12) Low levels of initia-
tive, vocabulary, standards of workmanship, per-
sistence, concentration, reasoning, defining,
descriminating, analyzing. (13) Ease of confusion;
fears, anxieties. (14) Laziness--but perhaps due
to ill health or emotional maladjustment rather
than as a constitutional factor. (15) Actions
based on impulse; insistence on quick results;
inclination toward jumping to conclusions.
(16) Less well-developed physically--height,
weight, proportion, general health, unexplained
fatigue.[1]

In the definition of low achiever several special
terms were used to denote different kinds of low achievers.
Characterisitcs of low achievers other than slow learners
include some of the following: lack of interest, dislike of
mathematics, quick rate of forgetting, afraid of mathematics,
reared in a culture with meager educational background,
unable to generalize, has difficulty transferring knowledge,
and weak motivation for learning.

Attitudes, interests, and ambitions of low achiever
are similar to those of the average pupils. The slow
learner faces many of the same pressures normal children
face but are less able in many instances to cope with these
pressures. The feeling of being left out of some activities
may cause added frustrations. The slow learners tend to
have fewer interests than other pupils. Research shows

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[1]Willard Abraham, The Slow Learner (New York: The
Center for Applied Research in Education Inc., 1964), p. 18.

that the favorite high school subject of the low achiever
is shop and the subject least often chosen is English.
Tests show that knowledge of world affairs is an area in
which low achievers obtain lowest scores.[1] Ambitions of the
low achiever are often too high, stimulated by high parental
ambition. To avoid later frustration and dissension, need
for child and parent guidance is necessary in all areas;
ambition, interests and attitudes.

To summarize briefly: the low achiever has nearly the
same characteristics as other pupils of the same age; many
of the same basic needs and interests. However, more than
the average child, he needs to be given the chance to ex-
perience success and approval; more than the others he needs
to feel that he is a member of the group with a contribution
to make; he needs status; his confidence must be re-established,
his interest stimulated, his attitude towards mathematics made
favorable, his ego flattered.

The list of weaknesses and limitations of slower
students given above may lead some to conclude that the
situation is hopeless, and that there is little use in
trying to improve materials for them. This is actually
far from the case. Rosenbloom says about the low achiever:
"No one knows much about these children's capacity to learn,

[1]Ibid., p. 24.

but the limits may be far beyond what they now learn."[1]
Brain comments: "Even though slow learners have a short
retention span, they can learn the sound, practical every-
day mathematics that they need in order to manage their
personal affairs wisely, and to qualify for jobs, and
perform them efficiently."[2]

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[1]Paul C. Rosenbloom, "Implications of Psychological
Research," The Low Achiever in Mathematics, Washington, D. C.:
U. S. Government Printing Office, 1965, p. 25.

[2]George B. Brain, "Mathematics for Low Achievers:
Responsibilities of School Administrators," The Low Achiever
in Mathematics, Washington, D. C.: U. S. Government Printing
Office, 1965, p. 34.

CHAPTER III

SUGGESTED METHODS FOR TEACHING THE LOW ACHIEVER

A number of suggestions have been made in regard to teaching the low achiever. Before presenting these suggestions a brief look is given at teacher qualifications, experimental teaching methods, and important factors to consider when teaching the slow learner.

TEACHER QUALIFICATIONS

Most teachers prefer teaching mathematics to college preparatory students. The slow learner has had a history of failure in arithmetic that conditions him against further work in mathematics. Most children (and adults) enjoy doing things in which they can succeed.

First, why should we educate the slow learner? The 1964 USOE-NCTM Conference sponsored by the U. S. Office of Education in cooperation with the National Council of Teachers of Mathematics stated the following basic assumptions about low achievers:

> Our nation needs the potential manpower of the low achiever in mathematics. Low achievers will not be qualified for future employment unless they learn more mathematics than they are learning now. The mathematical ability of low achievers can be developed to the extent necessary for a saleable skill. The low achiever should have the mathematics instruction necessary

for (a) a saleable skill, and (b) a rich cultural citizenship.[1]

A major factor in the success of any course is the ability of the teacher who teaches that course. No matter how good the text material, no matter how many visual aids are used, no matter what laboratory experiences are provided, an ineffective teacher can cause the failure of that course. This seems to be particularly true in the case of the low achiever. However, teachers of the slow learners encounter many problems and situations over which they have no control. They would like to see smaller classes. They wish that the chronic absentees, the discipline problems, the poor readers, the transients, and the indifferent were not all shoved into the general mathematics class. They would like to see pupils in their class who had had a series of experiences that would prepare them for the mathematics to be taught in the general mathematics class. They wish the classes were more homogeneous; instead they usually span a wide range.[2]

It is well known that many teachers of general mathematics are poorly prepared for their task, or dislike

[1]Bruce E. Meserve, "The Teaching of Remedial Mathematics," The Mathematics Teacher, 59:438, May, 1966.

[2]Sarah Greenholz, "Successful Practices in Teaching Mathematics to Low Achievers in Senior High School," The Mathematics Teacher, 60:329, April, 1967.

teaching the subject, or both. The following quotations
point up this situation.

> The academic prestige of general mathematics is
> low. It is frequently the practice to assign the
> teaching of this subject to the newest member if the
> mathematics staff, to the coach, or to any teacher
> whose schedule is not filled up, without regard to
> his qualifications to teach mathematics.[1]

Rosenbloom states, "In most schools the teachers of
slow learners are either the lowest in the pecking order in
their respective departments or specialists on low-ability
students with little special knowledge of mathematics."[2]

One of the greatest problems for the teacher of a
general mathematics class is to arouse interest within the
students. Use of many applications, plus a genuine interest
in the pupils and material presented will be of help in
providing motivation for the students. The following
qualities of the successful teacher have been suggested:
one who is sincerely interested in helping the slow learner
further his education; one who has a good mathematical
background and can present basic mathematical concepts in

[1]Edward Howard Matthews, "Proposed Training for Teachers
of High School General Mathematics," (unpublished Doctoral
Dissertation, George Peabody College for Teachers, June,
1954), p. 61.

[2]Paul C. Rosenbloom, "Implications of Psychological
Research," The Low Achiever in Mathematics, Washington, D. C.:
U. S. Government Printing Office, 1965, p. 24.

a simplified manner; one who has a rich background in
teaching aids and techniques; and one who has past teaching
experience.[1]

EXPERIMENTAL TEACHING METHODS

It is popularly believed that the manner in which the
general mathematics class is taught is the crucial factor
in the success or failure of the course. The following
studies explore different techniques of teaching general
mathematics classes.

Georgianna F. Thompson taught a general mathematics
class of forty-three in Shannon High School, Shannon, Miss-
issippi, using the deductive method for the first semester
and the inductive method for the second semester. The
deductive method derived specific applications or conclusions
from general principles, either assumed or previously estab-
lished. The inductive method was the presentation of enough
examples to allow the students to arrive at general relation-
ships implied. Achievement was measured in September by a
test of quantitative understanding, in January by a test on
problem solving, and in April by a test of basic computation.

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[1]Virgil Mallory, Education in Mathematics for the Slow
Learner, National Council of Teachers of Mathematics,
Washington D. C.: U. S. Government Printing Office, 1958,
p. 15.

No general conclusions were possible, since the tests were too dissimilar for comparison. However, weekly recitations and test performances were better during the second semester.[1]

Ruban D. Woodbury evaluated methods of teaching ninth-grade mathematics in Cedar City, Utah, Junior High School. His measures included: (1) IQ scores; (2) scores on the Cooperative Mathematics Achievement Test (two forms were used, pre-test and post-test); (3) scores on the Cooperative Algebra Achievement Test; (4) an open-ended question relating to attitude; (5) scores on the Kuder Preference Record. The findings relating to general mathematics were: (1) Achievement in general mathematics classes was better when the classes were taught by the spiral or functional method rather than the traditional method. (2) Positive responses to mathematics were better when general mathematics was taught by the traditional, rather than the paced, method; (3) There was no definite relationship between general achievement in mathematics and the computational score on the Kuder Preference Record.[2]

[1]Kenneth E. Brown, John J. Kinsella, Howard Fehr, Sheldon Myers, Fred Weaver, Analysis of Research in the Teaching of Mathematics, 1959 and 1960. OE-29007-60, U. S. Office of Health, Education, and Welfare. Washington, D. C.: U. S. Government Printing Office, 1963, p. 65.

[2]Ibid., p. 68.

Stephen Krulik explored the possibility of teaching
mathematics to slow learning children through the use of
topics not usually included in their curriculum. Pupils
were selected for the experiment if their IQ was between
seventy and ninety, if the pupil had a reading and arith-
metic retardation of two to four years on standardized tests,
and general agreement by pupils' previous term teacher that
he was a slow learner. Lessons on elementary statistical
concepts and on coordinate geometry were tape recorded as
they were being taught to the special classes. The tapes
were analyzed. The major conclusion was that mathematics
can be learned and retained by the slow learner if it is
made meaningful to him and is appreciated by him.[1]

Although formal evaluation is not complete the mathe-
matics project directed by Dr. Jack L. Foley in Florida
has gained national recognition. Several teaching techniques
are being employed, however, the student is of upper-most
importance at all times. The units were written by the
project staff using language of today's youth and problems
are taken from the teenagers' everyday world. When a unit
is completed it is evaluated by the teacher but also by the

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[1]Kenneth E. Brown and Theodore L. Abell, <u>Analysis of
Research in the Teaching of Mathematics</u>, OE-20007-62, U. S.
Department of Health, Education, and Welfare. Washington,
D. C.: U. S. Government Printing Office, 1965, p. 63.

students. Many of the illustrations have been drawn by
students. Parents and school personnel report much improve-
ment in student attitude and interest in mathematics and
other subject areas as well.

The use of a mathematics laboratory may be made at
any grade level. Valley High School in Albuquerque, New
Mexico, installed four mathematics laboratories for students
enrolled in general mathematics. Desks with specially
designed tops were used as well as a central reference
library. It is reported that these laboratories brought
new interest in mathematics to the students as well as the
teachers.[1]

IMPORTANT FACTORS TO CONSIDER WHEN TEACHING MATHEMATICS TO THE LOW ACHIEVER

There are several factors a teacher must consider
when teaching mathematics to the low achiever. These
factors will be identified and discussed separately in the
following paragraphs.

Interest. Dodes writes that interest is a result of
teaching skill, not of course material. The art of teaching

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[1]Marguerite Kluttz. "The Mathematics Laboratory--A
Meaningful Approach to Mathematics Instruction," The
Mathematics Teacher, 56:144, March, 1963.

he says is precisely this, "To make important materials
interesting. It is not to make interesting materials
important. Any expert teacher can make any topic interesting,
provided the topic is within the ability of the student."[1]

Motivation. Motivation based on marks, threats, or
punishment seldom produces better learning. We must turn
to hope rather than fear as the fundamental approach to
motivation. There are many essential ingredients of mot-
ivation such as curiosity that arouses a student; content
that challenges but does not frustrate him; the excitement
and satisfaction that comes from discovery of a new concept,
writing original problems, or construction of a model used
to illustrate an idea in class; a warm relationship between
teacher and student. Good motivation is based on the above
factors.[2]

Ability Grouping. A great advantage in teaching the
low achiever is ability grouping. More time with each
individual is possible. However, a note of warning must
be sounded; ability grouping helps narrow the range of

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[1]Irving Allen Dodes, "Some Comments on General Math-
ematics," The Mathematics Teacher, 60:247, March, 1967.

[2]Sol Weiss, "Innovations and Research in the Teaching
of Mathematics to the Terminal Student," The Mathematics
Teacher, 60:613, October, 1967.

differences but their will continue to be many differences among class members.

Introduction of new concepts. Being able to present an idea for the first time on a level the students understand is an important skill of a teacher. He should be able to introduce ideas in such a way that the learner can, and is given the opportunity to: actively engage in the development of ideas and convert them into his own thinking.[1]

Learning process. What activities are necessary for the student to assure that learning will take place? The learner must be allowed to develop and shape ideas, probe, regroup, simplify, experiment, manipulate, ask questions, seek answers and generalize. For each teacher the teaching process will be an individual style or approach. Suggestions for enhancing the learning process follow. Associate familiar and concrete examples that will permit the student to discover patterns and regularities. Ask questions often to be sure the students understand a concept and that the teacher understands a student's explanation. Encourage students to participate in class by writing original problems, discuss solutions and examples in their own language, and to introduce alternate solutions or methods of solution. Finally, requiring certain regimentation in class structure,

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[1]Ibid., p. 613.

method or language the teacher may be stifling enthusiasm, originality, or creativeness.[1]

Grading. How does the teacher determine grades in a general mathematics class? Greenholz presents this philosophy:

Give the student the mark that is best for him. If he tries, pass him. How do you motivate him and justify his passing in the eyes of the rest of the class? Since people are not born with equal talents, it is not fair to set a cutoff point on a test and let this determine who passes. Give him credit for daily work turned in, on recitation in class, on a notebook, or on problems assigned for extra credit. Raise an F to a D if the paper is corrected properly.[2]

This system will aid the teacher in motivating the low achievers without giving too many low marks. Schools should then indicate on a student's transcript the level of the class. This would explain to an outsider the meaning of a high grade in mathematics and low grades in other classes. For computation of class standing weight is given to various class levels and the marks given in those classes.

In summary, the following conditions will be helpful in teaching the low achiever. First, the teacher must recognize individual differences. One of the purposes of the school should be to help the pupils achieve at their highest

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[1]Ibid., p. 614.

[2]Sarah Greenholz, "Successful Practices in Teaching Mathematics to Low Achievers in Senior High School," The Mathematics Teacher, 60:330, April, 1967.

level; and an attitude toward slow learners should not be one of penalizing them simply because they are different from the average student. The classroom setting should be one in which the students know that their best possible performance is expected. This means that the teacher must know the mathematical level of each pupil and must help him set goals to raise that mathematical level.[1]

TEACHING METHODS SUGGESTED BY
NOTED MATHEMATICIANS

Suggestions for teaching the low achiever have been made by several groups and individuals. The SMSG panel for planning a program for students of average and below-average ability in mathematics proposed the following guidelines for the modification of their usual text materials:

1. Adjust the reading level downward.
2. Shorten the chapters.
3. Provide variation in content from chapter to chapter.
4. Shorten sections within each chapter.
5. Introduce new concepts through the use of concrete examples.
6. Provide chapter summaries, chapter reviews, and cummulative sets of problems.[2]

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[1]Lee E. Boyer, "Provisions for the Slow Learner," The Mathematics Teacher, 52:256, April, 1959.

[2]Bruce E. Meserve, "The Teaching of Remedial Mathematics," The Mathematics Teacher, 59:439, May, 1966.

There are many teachers who teach slow learners with
great skill. What are their techniques? Success is of
utmost importance. Start the year with easy concepts and
assignments until the students have confidence in themselves.
Then, begin to require better explanations and more precise
work. Each lesson should still begin with easy problems
which everyone can do and end with some challenging ones.
Return the corrected papers as soon as possible or check
them in class to receive maximum benefit from learning in
a testing situation. Give many short tests; give a test as
soon as a concept is learned. When correcting tests give
partial credit when part of the computation is correct or
circle that part that is wrong.

What does the successful teacher do about a student
who will not do the work required? If there is no apparent
reason for not working the student may be testing the teacher.
In this case the teacher cannot force the student to do
anything but must rely on honest praise and encouragement
to motivate the pupil. The teacher can remind the child
of the opportunity missed by not learning mathematics and
that this decision is entirely his own. Also, students
who rebel against contributing to class discussion or
putting work on the board should not be argued with but
allowed to watch as others are praised for taking part in

class recitation. Outside the classroom the teacher should be friendly with the students and know them by their first names. Treat them as adults; do not try to be friends by using their language and imitating their mannerisms. Know the activities of your students and use this knowledge to derive examples and problems from areas in which the students are interested. Try to involve the students in a personal way in each lesson.

Make each daily lesson complete within itself. This makes it possible for absentees to participate in class each day they are at school and it is easier to accept new class members. Homework done incorrectly can be damaging to the confidence of the child. Provide supervised study during the class period or if homework is necessary be sure it is very simple and that students have done some of these problems before they leave class. Homework can be given for extra credit but remember some students do not have study time after school or have a home life conducive to good study habits.

Provide more than one approach to a new concept or idea. Allow the student to perceive this new learning through several senses at a time as in seeing, hearing, manipulating, dramatizing and doing. Try to start each lesson with real objects or at least a picture or diagram.

This approach captures the pupil's attention, a most important factor in good teaching. Plan a frequent change of activity as the attention span of low achievers is short. Class activities for one day might include: warm up oral practice, readiness, discussion or laboratory experience to discover the new concept, group practice, and supervised study. Keep work sessions requiring a high degree of concentration short and interject some talking or organized moving around frequently during the lesson.

Be sure assignments and directions are clear to the student. Writing them on the board in the same place every day will be helpful.

Another factor to consider when giving examples to illustrate a new concept is to keep the computation simple. The student should not get bogged down with the arithmetic and lose sight of the original concept being introduced.

Don't insist on verbalization if it is clear that the student understands the idea. Allow descriptions and examples as answers. Do not embarrass a student by demanding an answer.

Think of new and original methods of review. Mathematical games, puzzles, or contests may be very effective. Use the overhead projector. Time spent to prepare overlays is well spent if just one student suddenly grasps a new

concept or idea being presented.[1]

Following is a sample lesson for the low achiever. The lesson is designed to illustrate some of the principles mentioned above and should take forty-five minutes to present.

Sample Lesson. The lesson to be presented is about measurement and particularly diameter, radius, and circumference. Begin class by setting an empty, circular waste basket on the desk. Also, place some string and a measuring stick where they can be seen. Ask two students to come before the class and measure the circumference of the top of the waste basket with string and then find the length of the string with the measuring stick. Select another student to record this measurement on the board under a column headed "Circumferences." Now ask the same two students to measure the diameter of the circle with string or the measuring stick and record this measure with the corresponding circumference measure under a column headed "Diameters." This same procedure should follow, measuring the other end of the waste basket, a circular plate, or any other appropriate object that can be supplied. Use different students for each object. Three or four measurements will be sufficient.

[1]Sarah Greenholz, "Successful Practices in Teaching Mathematics to Low Achievers in Senior High School," The Mathematics Teacher, 60:334, April, 1967.

A discussion will follow to discover the relationship between circumference and diameter. By comparing the two columns of numbers the relationship should be seen. It will be easier for the students if approximate measures are used, that is, accuracy to one-half inch would be more appropriate for this lesson than a precise measurement. If the students have trouble finding the relationship or if some students think they know the answer ask a student to draw with the aid of a black board compass a circle on the board. Let another student draw the diameter and then let student who thinks he has the answer tell the class what the approximate diameter should be. Then, let this student and a helper cut a string this length and measure the circle to test his solution. When the correct relationship has been found, use the same deductive process to arrive at the formula for circumference. Introduce pi when the formula C=3d has been agreed upon by the class. A brief lecture by the teacher on the history and actual value of pi will follow, (not to exceed five minutes). Now hand out a work sheet with six circles and their diameters drawn. Instruct students to find the circumference of each of the circles. A brief discussion may follow on methods to be used. Each student should have a ruler to use. The teacher should walk around the room to assist those having trouble. Radius may be introduced when all students have finished the work sheet. Then direct the student to find the

radii of the six circles. In the remaining class time the
work sheets should be checked and a short oral review planned.
Time in this lesson could have been devoted to accuracy of
measurement, spelling of these new words, and the use of
simple examples to illustrate the use of these measurements
in everyday situations. The writer would extend this lesson
and begin the next day with a basketball and finding the
diameter when the circumference has been measured. A review
of the day before will be necessary and a short test at the
end of the lesson will end this learning experience. This
lesson included many student activities which may be accom-
panied by teacher questioning other students to be sure they
understand the idea being taught. These important goals were
stressed in the above lesson: developing interest and par-
ticipation, good work habits, successful experiences, and
providing leadership.

What can the classroom teacher do in the meantime--
tomorrow--to help his terminal students and himself while
research studies and programs are being planned?

1. We can look into our own classrooms, into our own
schools, for answers to some of the questions that have been
raised in this chapter. For instance,

A. Are our students more successful with one type
of content than with another?

B. What materials and methods that we have used

seem to be more effective with the low achiever?

2. The teacher should devise his own teaching aids
to accompany units and topics taught.

3. Exchange ideas with other teachers. The industrial
arts teacher may be able to suggest areas in which mathematical
improvement would benefit the student's ability in industrial
arts.

4. Break away from meaningless drill and review
methods used week after week. Introduce probability, non-
metric geometry, modular arithmetic, and logic as a means
of teaching the fundamental process of working with numbers.

5. The teacher must define in his own mind what is
meant by "mathematics." If he regards mathematics as
essentially computation then he will teach it one way, but
if he looks at mathematics as a way of thinking, then he will
teach it another.

6. In planning each days work, plan not only what to
teach but also how to teach it. Decide what methods of mot-
ivation will be used, what examples will be used to illustrate
new concepts, and decide what aids could be supplied to
make the lesson more meaningful.

7. Do not set learning standards that are beyond the
reach of the students. This will be frustrating both to the
teacher and his students.

8. Keep abreast of current education practices and

research. Try some of these new ideas in your own class-room and carry on action research to provide answers to questions you may have.

Remember: A good mathematics program, even an exciting one, can be taught just as poorly as a bad program--with similar results.[1]

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[1]Sol Weiss, "Innovations and Research in the Teaching of Mathematics to the Terminal Student," The Mathematics Teacher, 60:617, October, 1967.

CHAPTER IV

TEACHING MATERIALS CURRENTLY AVAILABLE

Mathematics teachers and administrators choosing mater-
ials for classes composed of low achievers face a difficult
problem. Many text books available are not changed in format
from previous general mathematics text books. The student
sees a familiar hard back text book and expects another year
of struggle and frustration with the same problems he en-
countered in previous years of junior high mathematics. Later
in this chapter there is a discussion of current text books
available.

An approach taken by many teachers is to develop units
to supplement the text book. Following is a group of studies
in which units or courses for general mathematics have been
developed and tested in an experimental fashion.

Gerald A. Colwell prepared a unit on numeral systems
for ninth-grade general mathematics. In the unit, he
presented the Roman, Mayan, Egyptian, and Babylonian systems.
Then the Hindu-Arabic system was presented, with the positional
character of the system emphasized. The unit was taught in
several classes over a three-year period; it was found that
the attitude of students toward computation was improved.[1]

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[1]Kenneth E. Brown and Theodore L. Abell, <u>Analysis of
Research in the Teaching of Mathematics</u>, OE-29007-62, U. S.

Holtan carried out a study in which he investigated the relative effectiveness of four types of instructional motivational vehicles on achievement of general mathematics students. The unit was a linear-response programmed booklet, which was identical in all cases, except for the applications. Four types of applications were used: (1) automobile--chosen for student interest; (2) farming--this was vocational, since the study was carried out in a farming region; (3) social utility (insurance, taxation, social security, purchase of groceries and clothing, savings accounts)--chosen for its past history of use in general mathematics; (4) intellectual curiosity (examples about numbers)--chosen because this is related to the new mathematics programs. His study involved 136 males from fourteen general mathematics classes. Interest levels were determined by means of the Kuder Preference Test, Vocational, Form C. The twenty students lowest and the twenty students highest in interest in each of the four areas were assigned to that material. The unit took two class days, and was followed by a sixty-two item test, which was repeated three weeks later to get a measure of retention. The only significant differences found were between interest levels, and this difference remained significant in the retention test.[1]

Department of Health, Education, and Welfare. Washington, D.C.: U. S. Government Printing Office, 1965, p. 38.

[1]Boyd Holtan, "Motivation and General Mathematics Students," The Mathematics Teacher, 57:20-25, January, 1964.

Krulik reported on work he had done with a class of
thirty slow learners in the Bedford-Stuyvesant area in
Brooklyn. These students were defined as slow learners by
the following criteria: (1) IQ 70-90; (2) retarded by at
least two years on the Stanford Reading Achievement Test;
(3) retarded by at least two years on the New York City
Arithmetic Achievement Test; and (4) the opinion of previous
teachers. Krulik found through an experimental approach to
simple statistical ideas that the concepts of mean, median,
and mode were well-learned and retained. Simple work on the
language of sets, including definition of finite sets, set
equivalence, union, and intersection, met with a fair degree
of success. Besides the learning which took place, Krulik
reported positive changes in student attitude toward doing
homework, in the class atmosphere, and in attendance.[1]

Drake described a statistics unit which was developed
over a six-year period at the University of Minnesota High
School, and used successfully with ninth-grade mathematics
students. Observers made notes each year during the teaching
of the unit, and these notes were used as a basis for revision.

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[1]Stephen Krulik, "Experiences with some Different Topics
for Slow Learners," New Developments in Secondary-School
Mathematics, reprinted from the Bulletin of the National
Association of Secondary-School Principals, No. 247, May, 1959,
for the National Council of Teachers of Mathematics, pp. 43-
46.

The unit included the organization and arrangement of data, using tables, histograms, and frequency distributions; the calculation of means and medians; the suitability of the mean or median in a given situation; rounding off numbers; figuring quartiles, deciles, and percentiles; and the preparation of profile graphs and percentile graphs.[1]

Two national groups have attempted to meet the problems of the general mathematics class. First, SMSG (School Mathematics Study Group) developed a series of materials known as Introduction to Secondary School Mathematics and Introduction to Algebra. These materials are aimed at the middle fifty percent of the student body. As such, they reach some of the students in a typical general mathematics class--a number of schools use the Introduction to Algebra materials for two years with such students. It is even suggested that, for the very slow, Introduction to Secondary School Mathematics would be appropriate for grades 9 and 10, with the Introduction to Algebra used in grades 11 and 12.[2]

The NCTM's Committee on Mathematics for the Non-College Bound has written a text, Experiences in Mathematical Discovery.

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[1]Richard M. Drake, "Statistics for Ninth Grade Pupils," The Mathematics Teacher, 34:16-22, January, 1941.

[2]Max A. Sobel, "The 'M' Materials of SMSG," The Low Achiever in Mathematics, Washington, D. C.: U. S. Government Printing Office, 1965, p. 60.

This text is actually a series of ten self-contained units, each of which is designed for use by students of ninth-grade general mathematics. Titles in the series are as follows: (1) Formulas, graphs and patterns (2) Properties of operations with numbers (3) Mathematical sentences (4) Geometry (5) Arrangements and selections (6) Mathematical thinking (7) Rational numbers (8) Ratios, proportions, and per cent (9) Measurement and (10) Positive and negative numbers. NCTM is carrying out a research study comparing the "text" with conventional general mathematics texts. The units, Experiences in Mathematical Discovery were written for students in the 25th-50th percentile range. Thirty-five teachers are involved in the experiment, each teaching one class of the EMD text and one class of conventional general mathematics. In these classes, 994 students are in the EMD text, and 985 are in conventional texts. Comparisons are being made between achievement in the EMD text and in conventional texts, achievement among students using different conventional texts, attitude, and the relationship between change of attitude, and student achievement. Teacher attitude is also being sampled. Moreover, the EMD text was checked for readability with the Flesch Reading-Ease Formula, as adapted for mathematics materials. The mean reading scores by chapters ranged from 8 to 11.5, and the overall mean was 9.0. It was

recommended that, in revision, the reading level be lowered
to between 7.0 and 8.0.[1]

Findley evaluated the effectiveness of the text book,
Advanced General Math, written by Eldert A. Goeendyk and
published by Central University of Iowa Press in 1964. This
text with its different approach to general mathematics
requires the use of calculators and flow charts. It is a
collection of real-life problems drawn from businesses and
industries all over the Midwest and Plains States. Three
experimental classes were established in two similar junior
highs in Des Moines, Iowa. One teacher in each junior high
taught all three classes. Findley tried to find differences
in achievement gains made by students who used this text and
calculators, students who used a traditional text and cal-
culators, and students who used only the traditional text
during one semester. The experiment lasted the whole year
and evaluations were done at the end of the semester and at
the end of the year. All students were given the _California
Arithmetic Test_, junior high level, Form W at the beginning
of the year. At the end of first semester all were given
Form X of the same test and Form Y was administered at the

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[1] Emil Berger, "Experiences in Mathematical Discovery,"
The Low Achiever in Mathematics, Washington, D. C.: U. S.
Government Printing Office, 1965, pp. 65-68.

and of the year. The only significant difference found was in favor of the group using the traditional text and calculators for an entire year when compared with the class using Advanced General Math and calculators. The greatest value from using the new text was realized during the first semester. There were favorable reports of attitude and general behavior of all students. Therefore, the conclusion that variety should be added to general mathematics both in materials and techniques is substantiated.[1]

Many textbooks written for low achievers and general mathematics classes are available commercially. Topics generally covered in these books are as follows: review of basic facts, common fractions, decimals, word problems, ratio, proportion, measurement, per cent, mathematical sentences and symbols, consumer mathematics (sales tax, making out bills, checking accounts, commissions, overtime pay, profit margins, installment buying, budgets, depreciation, discounts, borrowing, and time payments), insurance, taxes, signed numbers, probability, and geometric concepts.

Holt, Rinehart and Winston, Inc. have published General Mathematics, A Problem Solving Approach in 1967. This is a

two-book series designed to meet the needs of students enrolled in general mathematics courses. Trouble Shooting Mathematics Skills, 1963, was also published by Holt, Rinehart and Winston, Inc. This text is a source book of materials and discussions designed to help students who have had difficulties with the basic concepts and skills of elementary arithmetic and elementary problem solving. It may be used in grades 7-12. Addison-Wesley Publishing Company, Inc. has published Basic Modern Mathematics in 1965. This two-year series was written for capable, average and slower students. In 1966 D. C. Heath and Company published Mathematics in Daily Use. This book is to be used for a general mathematics class. No specific grade level is recommended.

Houghton Mifflin has published an eight-part general mathematics program for low achievers. Modern Mathematics for Achievement is a general mathematics text that departs from the traditional hard back text. These eight soft-bound texts are especially designed to enable high school students to acquire those basic mathematical understandings and skills which are so necessary in today's world. The text is tailored to interests and abilities of students with low mathematical ability and a poor mathematical background. This text has been written keeping student reading at a minimum, introducing mathematical terms in an informal manner, presenting problems that are appropriate for low

achievers, and limiting each lesson to two pages that can
be completed in one class period. The novelty of the eight
different booklets gives the student confidence not experienced
by those associating past unhappy experiences with the hard-
cover mathematics text. Research indicates that many low
achievers can not work problems from a conventional text
but were able to work these same problems when presented
on a single sheet of paper.[1] Great flexibility is possible
not only because some sections are starred indicating that
the section is more advanced or can be skipped for a minimum
treatment of a topic but each student can progress in a
booklet at his own speed. The completion of a lesson or
booklet is a great motivational boost for the student.
Content of this text includes development of skills using
the fundamental process of arithmetic, understanding the
decimal system, fundamental geometric concepts, ratio and
practical per cent problems, simple measurement, and problem
solving. Included with the text are progress tests, a
teachers's guide, and a teacher's annotated edition with
motivational techniques suggested.

Materials used in the experimental program in Palm Beach
County, Florida, are also in individual booklet form. Each

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[1] Marian Cliffe Herrick, _Teacher's Guide--Modern Mathe-
matics for Achievement_, Houghton Mifflin Company, 1966, p. 2.

is a unit and involve topics ranging from The Slide Rule to
Calculator Activities. Other units that are used: Metric
Geometry, Maneuvers on a Geo-Board; Divisibility; Number
Sequences; Volume and Surface Area; Patterns, Particulars
and Guesses; Square Roots and Right Triangles; Events and
Chance; and others. These units have been developed and
written by the people involved in the project. Notes are
made as the materials are used and the units will be revised
later. These materials are not available commercially as
many of them have not been sufficiently tested. As important
as the material is a booklet entitled Teaching Strategy
Booklet. A description of teacher techniques, methods, sug-
gested sequences, academic games, and suggested visuals are
included in this booklet.

It must be remembered that while careful selection of
materials is very important the outcome of the class will
be only as good as the use and treatment of these materials
has been.

CHAPTER V

CONTENT TO BE INCLUDED IN A
GENERAL MATHEMATICS CLASS

The content in most general mathematics classes is
determined by the text book used. Teachers have a number
of reasons for relying upon the textbook as a guide.
Research has not been able to tell them the best content
to include in such a course. And, as mentioned earlier in
this paper many are not qualified to write their own mat-
erial or are not motivated sufficiently to spend time
preparing extra units to present to low achievers.

Noted mathematicians are asking questions about class
content for the low achiever such as: Should he be taught
applications? Should the structure of mathematics be
emphasized? Should the student be taught the traditional
sequence of algebra and geometry in a simplified manner?
Should the approach to be used in general mathematics
include some of the flavor of modern programs? Who should
decide general mathematics class content? What are the
mathematical needs of industry that should be included in
a mathematics program for the low achiever? What is the
degree of mathematical literacy for citizenship that will
be required of these students? These questions are being

asked in hope that individuals and groups will carry on research in effort to find answers to these questions.

There are some promising experimental programs now in process that have gained nation wide acclaim. Baltimore's Basic Program in Secondary Mathematics is a six-year program that has been in progress since 1958. Evaluations show that students enrolled have not only maintained, but have improved their mathematical competencies. Also, since these students have been grouped together and given a program designed for them, mathematics has had a greater holding power for them. For a more detailed description of content used in the Baltimore Program see Appendix A.

The Palm Beach County, Florida, experimental program does not emphasize content as much as methods of presenting the material. Sequence is of little importance either as policy in some classes allows the student to select the next unit he will study.

One of the objectives the writer proposed in the beginning of this paper was to identify suitable content for the low achiever at the secondary level. After reviewing the literature it is the writer's conviction that there is no true answer to this problem. Most of the literature suggested content that was a mixture of new approaches, new concepts, and a review of fundamental processes a mathematical

competent citizen might be expected to know. Also, the consumer mathematics and "everyday problems" would best be taught during the senior year when the student is more mature and closer to the time of actual use of this knowledge.

CHAPTER IV

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

SUMMARY

In this paper the general mathematics curriculum has
been looked at from a variety of points of view. The writer
presents opinions of noted mathematicians about general
mathematics and about the techniques of teaching the low
achieving student. The research dealing with general
mathematics has been examined and some of the experimental
programs which hold promise for the future of the low
achiever's curriculum have been reviewed. Materials currently
available to aid the teaching of general mathematics are sur-
veyed. The writer discusses content for the general mathe-
matics class for low achievers and finally, the characteristics
of low achievers and the qualities of teachers of low achievers
are presented.

CONCLUSIONS

This paper presents no panaceas. Nor does it solve
any great problems. It tries to express the plight of the
low achiever in mathematics and to urge those responsible
for his program to improve this program as fast as reserach
will allow. Because, the general mathematics student will

continue to exist and the general mathematics program will continue to need improvement.

The following statements are presented as conclusions. The low achiever must be educated to the fullest extent possible. By means of better teaching methods the slow learning child can be helped to greater achievement and an increased interest in learning. Therefore, the child is more likely to stay in school longer. Increased training in mathematics opens more doors on the labor market as well as making possible increased vocational training.

Each low achiever must be treated with a certain amount of individuality because of the many causes of low achievement. Recognizing the particular cause of low achievement of a child whether it be lack of interest, a negative attitude toward mathematics, rejection by teachers or peers, below average academic ability or inadequate mathematical background will help the teacher direct the child toward successful activities. Important factors that every teacher must consider when teaching a low achiever follow: The student must be able to experience success; the new learning must be in someway related to past experiences of the student; new learning should be introduced in simple language and follow from concrete examples; and each lesson must contain a variety of approaches and activities to interest and motivate the student.

A factor that cannot be emphasized too much in the general mathematics classroom is the attitude of the teacher. The teacher who is sympathetic and considers every question an important one will earn student respect. Also, the teacher must have a good knowledge of mathematics so that learning processes can be presented as a series of simpler units of learning; also that a variety of approaches can be presented in one particular learning process.

Certainly it must be concluded that research in the area of mathematics for the low achiever has barely scratched the surface. Better methods of preparing teachers to teach the low achiever must be found. Course content for low achievers should be developed. Materials written so the low achiever can comprehend what is being said and expressed in language that is meaningful is necessary. Experimental units and materials need to be tried out in different classrooms situations and reported. Developing a guidance system so students may be properly placed in mathematics is also important to the program for low achievers.

RECOMMENDATIONS

Recommendations made by noted mathematicians in the area of general mathematics for the low achiever appear in Appendix B.

Some recommendations that the writer has inferred from

reviewing the literature and observation complete this
chapter.

Larger numbers of mathematics teachers should exper-
ience the teaching of a slow learner before they leave the
college or university. Since many first year teachers are
assigned one or more classes of general mathematics or
classes at the junior high level they should be given mean-
ingful experiences that will help them teach the low achiever.
Many prospective teachers have not encountered a slow learner
in their previous eight years of school work.

There is a need for administrators and school personnel
becoming better prepared to help the teachers of low achievers.
Guidance personnel can be especially helpful by providing
information about the low achiever. Teachers need encourage-
ment and recognition for their work with the slow students.

Finally, more literature should be available to help
teachers requesting information about low achievers: what
to teach and how to teach these students. Much research
is done but not reported in a manner readily accessible by
the teacher. State or national centers to coordinate
research and information are necessary for the improvement
of mathematics programs throughout the nation for the low
achiever.

BIBLIOGRAPHY

BIBLIOGRAPHY

A. BOOKS

Abrahsm, Willard. _The Slow Learner._ New York: The Center
For Applied Research In Education Inc., 1964.

Johnson, Donovan A. and Gerald R. Rising. _Guidelines for
Teaching Mathematics._ Belmont, California: Wadsworth
Publishing Company Inc., 1967.

Sobel, Max A. _Teaching General Mathematics._ Englewood
Cliffs, New Jersey: Prentice-Hall Inc., 1967.

B. PUBLICATIONS OF THE GOVERNMENT, LEARNED SOCIETIES, AND OTHER ORGANIZATIONS

Brown, Kenneth E. and Theodore L. Abell. _Analysis of
Research in the Teaching of Mathematics._ OE-20007-62.
U. S. Department of Health, Education, and Welfare.
Washington D. C.: U. S. Government Printing Office, 1965.

Brown, Kenneth E., John J. Kinsella, Howard Fehr, Sheldon
Myers, and Fred Weaver. _Analysis of Research in the
Teaching of Mathematics, 1959 and 1960._ OE-20007-60.
U. S. Office of Health, Education, and Welfare.
Washington D. C.: U. S. Government Printing Office, 1963.

Herrick, Marian Cliffe. _Teacher's Guide, Modern Mathematics
for Achievement._ Houghton Mifflin Company, 1966.

Krulik, Stephen. _New Developments in Secondary-School
Mathematics._ Reprinted from the Bulletin of the
National Association of Secondary-School Principals,
No. 247, May, 1959, for the National Council of
Teachers of Mathematics.

National Council of Teachers of Mathematics. _The Revolution
in School Mathematics._ Washington D. C.: National
Council of Teachers of Mathematics, 1961.

Potter, Mary and Virgil Mallory. _Education in Mathematics
for the Slow Learner._ National Council of Teachers of
Mathematics, Washington D. C., 1958.

Woodby, Lauren G. <u>The Low Achiever in Mathematics.</u>
Washington D. C.: U. S. Government Printing Office,
1965.

C. PERIODICALS

Begle, E. G. "SMSG: The First Decade," <u>The Mathematics
Teacher,</u> 61:239-245, March, 1968.

Boyer, Lee E. "Provisions for the Slow Learner," <u>The
Mathematics Teacher,</u> 52:256-259, April, 1959.

Brown, G. W. "Improving Instruction in Problem Solving in
Ninth Grade General Mathematics," <u>School Science and
Mathematics,</u> 64:341-346, May, 1964.

Dodes, Irving Allen. "Some Comments on General Mathematics,"
<u>The Mathematics Teacher,</u> 60:246-251, March, 1967.

Drake, Richard. "Statistics for Ninth Grade Pupils," <u>The
Mathematics Teacher,</u> 34:16-22, January, 1941.

Easterday, Kenneth E. "A Technique for Low Achievers,"
<u>The Mathematics Teacher,</u> 58:519-521, October, 1965.

Easterday, Kenneth E. "An Experiment with Low Achievers
in Arithmetic," <u>The Mathematics Teacher,</u> 57:462-468,
November, 1964.

Elder, Florence. "Mathematics for the Below-Average
Achiever in High School," <u>The Mathematics Teacher,</u>
60:235-239, March, 1967.

Findley, Robert Earl. "An Evaluation of the Effectiveness
of a Textbook, <u>Advanced General Math,</u> Used by Ninth
Grade General Mathematics Classes, <u>Dissertation
Abstracts,</u> 27:2440, February, 1967.

Fremont, Herbert. "The Hidden Potential of Low Achievers,"
<u>The Mathematics Teacher,</u> 59:551-557, October, 1966.

Greenholz, Sarah. "Successful Practices in Teaching
Mathematics to Low Achievers in Senior High School,"
<u>The Mathematics Teacher,</u> 60:329-335, April, 1967.

Holtan, Boyd. "Motivation and General Mathematics Students,"
<u>The Mathematics Teacher,</u> 57:20-25, January, 1964.

Kluttz, Marguerite. "The Mathematics Laboratory--A Meaningful Approach to Mathematics Instruction," The Mathematics Teacher, 56:141-145, March, 1963.

Lankford, Francis, G. "Practical Mathematics Is Challenging to Students," The Mathematics Teacher, 48:401-405, October, 1955.

Mehl, William G. "Providing for the Basic Student in the Junior High School," The Mathematics Teacher, 53:359-362, May, 1960.

Meserve, Bruce E. "The Teaching of Remedial Mathematics," The Mathematics Teacher, 59:437-443, May, 1966.

Proctor, Amelia D. "A World of Hope--Helping Slow Learners Enjoy Mathematics," The Mathematics Teacher, 58:118-122, February, 1965.

Sasse, Katherine J. S. "Mathematics for the Noncollege-bound in Junior High School," The Mathematics Teacher, 58:232-240, March, 1965.

Sobel, Max A. "Providing for the Slow Learner in the Junior High School," The Mathematics Teacher, 52:347-353, May, 1959.

Weiss, Sol. "Innovations and Research in the Teaching of Mathematics to the Terminal Student," The Mathematics Teacher, 60:611-618, October, 1967.

Willerding, Margaret F. "Stimulating Interest in Junior High Mathematics," The Mathematics Teacher, 52:197-201, March, 1959.

Wilson, Jack D. "What Mathematics for the Terminal Student?" The Mathematics Teacher, 53:518-523, November, 1960.

D. UNPUBLISHED MATERIALS

Matthews, Edward Howard. "Proposed Training for Teachers of High School General Mathematics," Unpublished Doctoral Dissertation, George Peabody College for Teachers, June, 1954.

APPENDIXES

APPENDIX A

The basic mathematics program in the Baltimore Secondary
Schools began in the seventh grade in 1958. It continued
each succeeding year in the next grade level so that by
September 1963 the original group was enrolled in a twelfth
grade basic mathematics course. Students were specially
selected for the program and the teachers met for group
orientation. Topics covered in the seventh and eighth
grades follow the regular program closely so that students
can transfer into the regular program without difficulty.
Throughout the entire program differentiation is made in
levels of learning, depth, and scope. As compared to the
regular program, the amount of concrete background is
enlarged and the rate of presenting new material is decreased.
Topics included in the content at each grade level is
given below.

Seventh Grade	Eighth Grade
Geometric Forms	Working with the Decimal
Graphs	System
Linear Measurement	Percentage
Triangles	Measurement
Number System	Applications of Per cent
Measurement of Angles	Circles
Areas of Plane Figures	Measurement of Solids
Applications of Per cent	Evaluation of Formulas
	Equations and Problems
	Directed Numbers

Ninth Grade	Tenth Grade
Equations and Formulas	Earning Money
Directed Numbers	Budgeting
Graphic Representation	Buying Wisely
Constructions	Installment Buying
The Right Triangle	Home and Job Mathematics
Ratio and Proportion	Borrowing Money
Indirect Measurement	Taxation
Applications of Per cent	Insurance
	Banking and Investments

Eleventh Grade	Twelfth Grade
The Number System	Slide Rule and Computer
Number and Operation	Mathematics
Numbers in Measurement	Personal Finance
Rational Numbers	Buying and Owning an
Numbers in Per cent	Automobile
Angles and Polygons	Renting and/or Buying a
Equations	Home
Perimeters and Areas	Income Tax
Surfaces and Volumes	Industrial and Business
Ratio and Proportion	Applications
Indirect Measurement	Social Security and
Financial Transactions	Insurance
	Statistics and Probability

Grades 7-10 meet five periods each week, grade eleven meets four days a week, and grade twelve meets only three days a week.

Evaluation by means of the Stanford Achievement Test, the Snader General Mathematics Test, and individually designed departmental tests has shown that students enrolled in these classes have not only maintained, but have improved their mathematical competencies.[1]

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[1] William J. Gerardi, "Baltimore's Basic Program in Secondary Mathematics," The Low Achiever in Mathematics, Washington D. C.: U. S. Government Printing Office, 1965, p. 49-53.

APPENDIX B

Recommendations by Bruce Meserve, past president of the National Council of Teachers of Mathematics, and the 1964 USOE-NCTM Conference on the Low Achiever in Mathematics are cited in this appendix.

Meserve suggests that teachers and administrators should be concerned with the several deficiencies of the low achiever and be ready to offer several kinds of remedial classes. This would then demand a guidance program that could properly place students in these classes. The general mathematics curriculum should include many student activities within the classroom. The teacher should emphasize doing rather than using the lecture-recitation method. Such activities as building and developing mathematics models, presenting concrete examples, and participating in recreational mathematics can help the student discover the spirit of mathematics. Finally, the general mathematics class should introduce: new concepts, new approaches to review sessions, new patterns between familiar elements, and new properties. Also, another attempt toward establishing a sound background for those concepts students have not understood before should be made in the general mathematics class.[1]

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[1] Bruce E. Meserve, "The Teaching of Remedial Mathematics," The Mathematics Teacher, 59:440, May, 1966.

At the close of the 1964 USOE-NCTM Conference on the low achiever in mathematics the following recommendations were made. There were four primary recommendations:

1. To establish a national commission on mathematics for low achievers.

2. To establish reserach and development centers.

3. To extend the research effort.

4. To develop inservice programs for teachers.

Some of the activities of the proposed national commission would include providing a center for distributing information about the low achiever, publishing a yearbook for teachers to help them in their teaching of low achievers, to establish lines of communication between industry, business, government agencies and educational agencies and to promote cooperation between agencies. Some suggested studies to be done by individual reserachers rather than by the research and development centers are (1) study the effectiveness of mathematics teachers who have been specially prepared to teach low achievers. (2) Study means of communicating with parents of low achievers. (3) Study the effectiveness of teacher assistants in classes of low achievers. (4) Study the nature of poverty of experience. (5) Study the effectiveness of the discovery approach. (6) Study the effectiveness of the use of games. The seminar approach is suggested for inservice education for teachers now teaching low achievers.

It was also recommended that some professional recognition
be given those teachers with special talent for teaching
mathematics to the low achiever.[1]

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[1]Lauren G. Woodby, The Low Achiever in Mathematics,
Washington D. C.: U. S. Government Printing Office, 1965,
p. 77-81.

GUIDELINES FOR TEACHING MATHEMATICS

TO LOW ACHIEVERS

by

BARBARA ANN SWEAT

B. S., Kansas State University, 1963

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

College of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1968

The purpose of this study is to provide guidelines for
teachers of low achievers in preparing for general mathematics
classes. Specifically, the writer's objectives were to (1)
determine the characteristics of low achievers and develop
methods of presenting daily lessons that low achievers can
understand and learn, (2) find what materials are currently
available to help teach low achievers, and (3) identify a
suitable content for the low achiever at the secondary level.

Ambitions, interests attitudes, and other characteristics
of the low achievers are cited. Also discussed are the
qualities teachers of low achievers must possess to be suc-
cessful. Opinion of noted mathematicians are used to emphasize
the importance of factors such as motivation, the learning
process, grading, ability grouping, and introduction of new
ideas in the general mathematics classroom. Experimental
methods being used by teachers and nationally funded groups
are reported. The writer reviews teaching materials currently
available and presents class content currently being taught.

Research shows that work is just beginning on improving
the mathematics program for the low achiever. Several exper-
imental projects are in progress and there are many questions
still to be answered. Better methods of preparing teachers
to teach the low achiever, new materials written especially
for the low achiever, and proven teaching techniques are
needed.